APPLICATION FOR UNITED STATES LETTERS PATENT

TITLE:	LOCKING BOLT WORK APPARATUS FOR ATM
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CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Applications 60/396,642 filed July 17, 2002 and 60/453,647 filed March 10, 2003, the disclosures of which are incorporated herein by reference.

TECHNICAL FIELD

This invention relates to automated banking machines. Specifically this invention relates to a locking bolt work apparatus for a secure enclosure of an automated banking machine, and its method of assembly.

BACKGROUND ART

Automated banking machines are known in the prior art. Popular automated banking machines often used by consumers are automated teller machines (ATMs). ATMs are increasingly used by consumers to conduct banking transactions. Common banking transactions conducted by consumers at ATMs include deposits, withdrawals, account transfers, and balance inquiries.

Most ATMs include a secure enclosure. The secure enclosure is used to hold currency and other valuable items inside the machine. Deposits made by customers into an ATM are also preferably held within a secure enclosure until they can be removed by authorized personnel. The secure enclosure also preferably houses portions of the mechanisms used for receiving deposits and dispensing currency. The secure enclosure also preferably houses electronic

components of the ATM which may be subject to attack by someone attempting to compromise the security of the ATM or the electronic communications network in which it is operated.

Secure enclosures used in automated banking machines are specifically made for the type of machine in which they are used. Such enclosures, unlike most common types of safes or vaults, include multiple openings through the walls of the enclosure. These openings are precisely positioned. Such precise positioning is necessary to cooperate with the components of the ATM outside the enclosure. For example, an opening through the secure enclosure is required to enable a currency dispenser mechanism within the secure enclosure to pass currency notes to a delivery mechanism outside the enclosure that delivers the notes to the customer. Likewise a precise opening is required to pass deposit envelopes and other valuables from the deposit accepting opening and mechanism outside of the secure enclosure to the depository mechanism inside the secure enclosure. Similarly, wiring harnesses and other connectors for the electronic and alarm components within the enclosure extend through enclosure openings which must be accurately positioned to enable connection to other wiring or devices in the ATM that are outside the enclosure.

There are many types of ATMs. ATMs can be configured as lobby units, which are made to be used within the confines of a building. Other ATMs are made for "through the wall" installation which enables a user outside of a building to use the machine. ATMs vary in physical size due to a number of factors. ATMs that provide a wide variety of functions, such as passbook printing, ticket or stamp dispensing, check cashing and other functions must necessarily be physically larger than machines that do not provide such functions. Such

multifunction machines generally have secure enclosures that are much larger than machines that have fewer capabilities. ATMs that provide a single function, such as dispensing cash, often require a much smaller secure enclosure.

Secure enclosures for automated banking machines include, in connection with a moveable door, a locking bolt work apparatus. The locking bolt work is generally in a secure, locking condition when the door is closed. When authorized personnel act to open the door of the secure enclosure, such as by inputting a proper combination to a lock, the locking bolt work is moveable to a second unsecured condition. In the second condition of the bolt work the door is enabled to be opened so that components within the secure enclosure may be accessed.

Due to the incentive for burglars to attack ATMs, the bolt work and other locking mechanisms used in connection with the moveable doors of secure enclosures preferably provide a high degree of resistance to attack. However, providing enhanced security also often comes with a high degree of complexity. This increases the cost of the automated banking machine. Complex mechanisms can also make it more difficult for authorized personnel to gain access to the secure enclosure.

Thus there exists a need for a secure enclosure and a method of manufacturing a secure enclosure for an automated banking machine that is more reliable and economical.

There also exists a need for a locking bolt work apparatus for a door of an automated banking machine that provides enhanced security, but which is also economical with less complexity and which can be quickly opened by authorized personnel. There also exists the need

for a method of assembling the locking bolt work apparatus to a secure enclosure that can be readily accomplished in a more efficient manner.

DISCLOSURE OF INVENTION

It is an object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine.

It is a further object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine that is more readily accomplished.

It is a further object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine that is more accurate and reliable.

It is a further object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine that provides enhanced security.

It is a further object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine that includes a more secure bolt work apparatus.

It is a further object of an exemplary form of the present invention to provide a secure enclosure for an automated banking machine that includes a bolt work apparatus that may be more readily installed in the secure enclosure.

Further objects of exemplary forms of the present invention will be made apparent in the following Best Mode for Carrying Out Invention and the appended claims.

The foregoing objects are accomplished in an exemplary embodiment of the present invention by a secure enclosure for an automated banking machine that includes a bolt work

apparatus. In the exemplary embodiment of the invention the automated banking machine is an ATM. Precisely positioned openings extend through the secure enclosure. The openings enable cooperation between devices and mechanisms inside and outside of the enclosure, which enables the conducting of banking transactions.

The secure enclosure is a generally rectangular enclosure that includes five panels and a moveable door. The enclosure includes a front panel. The front panel is connected to a hinge side panel and a parallel spaced striker or lock side panel. The striker side panel further includes a plurality of vertically aligned apertures therethrough. The enclosure further includes a top panel and a parallel, spaced bottom panel. An opening to the enclosure extends on a side opposite the front panel when the door is in an open position. Each of the panels preferably includes precisely positioned access openings for cooperating with the components which make up the ATM.

The door has mounted thereon a locking bolt work apparatus or mechanism. The locking bolt work mechanism is moveable responsive to the condition of a lock, between a secure and an open condition. The bolt work mechanism includes a moveable locking bolt with a plurality of locking bolt projections. In the secure condition of the locking bolt the locking bolt projections extend in the apertures in the striker side panel of the enclosure. In the open condition the locking bolt projections are retracted from the apertures enabling movement of the door to the open position.

The locking bolt is moveable in response to an actuating mechanism. The actuating mechanism includes a drive cam. The drive cam is in operative to be secured by the lock and is

operative to be moved by a door handle when the lock is in an open condition. The drive cam is connected by a generally vertically extending long link to an idler cam. The drive cam and the idler cam are each rotatably moveable and positioned adjacent to a respective vertical end of the locking bolt. The locking bolt is connected to the drive cam by a generally horizontally extending short link. The locking bolt is also connected to the idler cam by another generally horizontally extending short link.

In the secure condition of the locking bolt, the drive cam and the idler cam are in adjacent abutting position with the locking bolt. In addition, an alignment device is operative to rotatably align the drive cam with the lock to enable locking of the drive cam. The alignment device may act as a stop to prevent further movement of the drive cam in a first rotational direction.

In response to unlocking the lock by authorized personnel, the drive cam of the actuating mechanism is enabled to be rotated. The drive cam can be rotated to cause rotation of the idler cam through the long link. The drive cam and the idler cam can be rotated together in a direction that results in the short links moving the locking bolt in an inward unlocking direction. The locking bolt is enabled to move sufficiently to disengage from the apertures in the striker side panel of the enclosure which enables opening of the door. Thus, the locking bolt work mechanism when arranged with a secure enclosure door enables the drive cam to be rotated in a first direction and a second direction to move the locking bolt relative to the door between an extended door-secured position and a retracted door-open position, respectively.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is an isometric view of a secure enclosure of the present invention for an automated banking machine, with a door thereof in an open condition.

Figure 2 is an isometric front view of the secure enclosure shown in Figure 1.

Figure 3 is an isometric rear view of the secure enclosure shown without the door.

Figure 4 is a side view of an exemplary embodiment of a locking bolt work apparatus of the present invention, in a secured position.

Figure 5 is a side view of the apparatus of Figure 4 in an unsecured position.

Figure 6 is a side view of a locking bolt.

Figure 7 is a top view of a drive cam arrangement.

Figure 8 is a top view of an idler cam arrangement.

Figure 9 is an isometric view of a drive cam and a retainer associated therewith.

Figure 10 is a side view of a long link.

Figure 11 is another side view of a long link.

Figure 12 is a top view of a short link.

Figure 13 is a side view of the short link of Figure 12.

Figure 14 is a side view of a short link having a hook portion at one end.

Figure 15 is a side view of a short link combined with a pin.

Figure 16 is a side view of a retainer.

Figure 17 is a side view of another retainer.

Figure 18 is a top view of an idler cam.

Figure 19 is a top view of a drive cam having a cut out and a groove.

Figure 20 is a front view of the cam of Figure 19 taken along the cut out.

Figure 21 is a cut away front view of the cam of Figure 19 taken along the groove.

Figure 22 shows a retainer portion resting in a groove of a cam.

Figure 23 is a side view of a retainer including a hook portion.

Figure 24 is a bottom view of a retainer with a passage.

Figure 25 is a bottom view of a retainer with plural passages.

Figure 26 is a side view of a retainer including a curved portion.

Figure 27 is a bottom view of a retainer applicable with an idler cam.

Figure 28 is a bottom view of a retainer similar to the retainer of Figure 27 but additionally including an aperture for a links' shaft.

Figure 29 is a top view of a long link and a short link arrangement.

Figure 30 shows the reversibility of the locking bolt work apparatus of the present invention.

Figure 31 shows an alternative locking bolt work apparatus.

Figure 32 shows an exploded view of Figure 31.

Figure 33 shows a door with stepped bosses.

Figure 34 shows a locking bolt secured to the door of Figure 33.

Figure 35 shows a door handle assembly.

Figure 36 shows an isolated view of a sleeve.

Figure 37 shows an isolated view of a door.

Figure 38 shows an isolated view of a handle.

BEST MODE FOR CARRYING OUT INVENTION

Referring now to the drawings and particularly to Figure 1, there is shown therein a secure enclosure arrangement for an automated banking machine of an exemplary embodiment of the present invention, generally indicated 10. It should be understood that the secure enclosure is part of a larger automated banking machine, such as an ATM or similar apparatus. The secure enclosure 10 includes a generally rectangular chest portion 12 and a moveable door 14. The chest portion 12 bounds an interior area 16 which has an opening 18 at a rear side of the chest. Door 14 is sized for closing opening 18. Door 14 is attached to chest portion 12 by an upper hinge assembly 20 and a lower hinge assembly 22.

Door 14 has mounted thereon a locking bolt mechanism 23. Door 14 further includes a dead bolt portion 26. The locking bolt mechanism 23 and the dead bolt portion 26 are operative to secure the door in position closing opening 18.

As shown in Figures 2 and 3 the chest portion of the secure enclosure includes a front panel 28. Front panel 28, in the embodiment shown, faces the customer side of the ATM. The front panel 28 includes openings 30. The openings 30 are sized for cooperating with mechanisms in the ATM. These mechanisms include, for example, a mechanism that delivers cash or other valuable items to a customer. For example, a supply of cash may be maintained within the secure enclosure in the ATM, and a picker mechanism may be provided for delivering the currency bills or notes that have been properly requested by a customer. The bills are

delivered out of the secure enclosure through one of the openings 30 to a mechanism in the ATM which delivers the money to the customer.

Other openings in the front panel 28 are used in connection with a mechanism that receives deposits from customers. Customers may insert deposits through an opening in a fascia of the ATM, and a mechanism delivers the deposit envelopes through an opening in the front panel 28 to another mechanism within the chest portion. Generally the mechanism places the deposit envelopes in a secure removable container within the enclosure.

The chest portion 12 further includes a hinge side panel 36 and a striker or lock side panel 38. The hinge side and striker side panels extend generally parallel from front panel 28. Striker side panel 38 includes a plurality of vertically aligned locking bolt apertures 46. Locking bolt apertures 46 preferably extend through the striker side panel at a position that is somewhat disposed inwardly from a front surface 48 of the panel which bounds the opening 18. Locking bolt apertures 46 are sized for accepting therein projections on a locking bolt in a manner later explained.

Chest portion 12 further includes a top panel 66. Top panel 66 includes an opening 72 for providing access between the components within the secure enclosure and other components of the ATM of which the enclosure is a part. Opening 72 in panel 66 provides access for electronic cabling which communicates with the components inside the chest. Such cabling may be used to transmit signals that control operation of the cash dispensing and depository mechanisms. In addition, wiring harnesses and other cabling provide connections to alarm devices and other equipment that are housed within the secure enclosure.

Chest portion 12 further includes a bottom panel 76. Bottom panel 76 includes access openings 77 for purposes of providing connections to the items within the secure chest. In addition, bottom panel 76 may include plural foot mounting openings (e.g., four openings). Foot mounting openings can accept adjustable feet 88 as shown in Figure 1. Adjustable feet 88 may be adjusted vertically for purposes of leveling and positioning the ATM of which the secure enclosure 10 is a part.

Door 14 also has a lock 34 mounted thereto. Lock 34 includes a lock bolt member 35 as shown in Figure 7. Lock bolt member 35 is a member that is moveable between extended and retracted positions. Lock bolt member 35 extends from the case of lock 34 when the lock 34 is in the closed condition. Lock bolt member 35 is retracted into the case of lock 34 when the lock is in the open condition. The lock is operative to be opened from outside of the door 14.

An example of an arrangement of a chest portion and a door for a secure enclosure of an automated banking machine and the assembly thereof may be found in U.S. Patent No. 6,089,168, the disclosure of which is incorporated herein by reference in its entirety.

An exemplary embodiment of a locking bolt work apparatus 24 is shown in Figure 4. The locking bolt work apparatus 24 includes a locking linkage arrangement. A drive cam 40 is connected to an idler cam 50 by a connector (e.g., cam link or lever or long link or L-Link) 52. Further embodiments of cam links 134, 196 are shown in Figures 10 and 11. The curved portion of cam link 196 may be used to avoid contacting the cam link with other structure associated within the enclosure. The cam links may have a passage therethrough at each end. The drive cam may be driven by authorized personnel using a door handle located on the exterior of the

door. It should be appreciated that the long link can be arranged to enable the idler cam 50 to rotate together in coordinated relation with the drive cam 40.

The drive cam 40 is connected to a locking bolt (e.g., lock bar) 60 by a link (e.g., bolt link or lever or upper short link or S-Link) 54. Similarly, the idler cam 50 is connected to the elongated locking bolt 60 by a link (e.g., bolt link or lever or lower short link or S-Link) 56. The bolt links 54, 56 are generally of the same length. Each of the bolt links 54, 56 may also be used with either the drive cam or the idler cam. The short links, 54, 56 are also generally shorter than the long cam link 52. Further embodiments of bolt links are shown in Figures 12-15. The bolt links may have a passage therethrough at one end. A bolt link's passage is able to be aligned with a passage of the cam link for operative connection therewith. Figure 12 is a top view of a bolt link 110. Figure 13 is a side view of the bolt link 110 of Figure 12. Figure 13 also shows the bolt link 110 having an end portion 120. The end portion 120 is typically shorter than an elongated portion 122 of the bolt link and also comprises a part which extends in a direction substantially perpendicular to the elongated portion. Figures 14-15 are also side views of respective bolt links. Figure 14 shows a bolt link 112 having a hook 114 at an end portion thereof to permit securement to a locking bolt 60. Figure 15 shows a bolt link 116 having a pin 118 attached or integral thereto. Figures 14 and 15 are explained in more detail below.

The locking bolt 60, which is separately shown in Figure 6, has openings or slots 62 to accept studs 32 therein. The studs may be directly attached to the door 14, such as by welding. Each of the studs comprises a head and a narrower neck in an axial direction. The slots 62 have a wide portion enabling passage of a stud head therethrough, and a narrower or neck portion

preventing passage of the stud head therethrough. The stud heads enable the locking bolt 60 to be secured to the studs. A stud, when the stud head is positioned overlaying a neck portion, prevents disengagement of the locking bolt therefrom in the axial direction of the stud. The studs are arranged and spaced in a manner to fully support the weight of the locking bolt 60. Thus, the locking bolt 60 is able to be supported by and move relative to the door 14. The openings 62 may be key shaped. The slots and studs are arranged so that after assembly of the locking bolt work mechanism the heads remain in the narrower portion during locking bolt movement. Thus, after assembly completion the locking bolt is prevented from disengagement with the door.

The studs may be fastened to the door in other fastening arrangements. For example, the studs may comprise shoulder bolts which extend into threaded bosses on the door 14. The shoulder bolts can support the locking bolt 60 and enable the locking bolt to slide in supported relation thereon. Although Figure 4 shows an arrangement using three studs 32 it should be understood that more or fewer studs may be used in other embodiments. Further, other arrangements may use a number of studs less than the number of slots in a locking bolt. This enables the same locking bolt to be used with different arrangements of studs, and hence different doors. Further arrangements may use locking bolt slots of different shapes.

The locking bolt 60 also has passages or openings 64 to receive an end portion of the bolt links 54, 56. The end portion may comprise a finger, lip, hook, or tab (e.g., Figures 13-15). Figure 13 shows a bolt link having an end portion 120 thereof to permit securement to a locking bolt 60. Figure 14 shows a bolt link having a hook 114 at an end portion thereof to permit securement to a locking bolt 60. The locking bolt openings 64 enable the bolt links 54, 56 to be

operatively engaged with the locking bolt 60. When the locking bolt work mechanism is assembled on a door, the bolt link end portions extend far enough into the locking bolt openings 64 so that they are prevented from disengaging from the locking bolt. As explained later in more detail, a keeper or retainer can be used to retain a bolt link end portion in engagement with the locking bolt. Pivoting movement of the bolt links 54, 56 relative to the locking bolt openings 64 results in sliding movement of the locking bolt 60 relative to the door.

The operation of the locking bolt mechanism 24 is now explained with reference to Figures 4 and 5. The drive cam 40 includes a groove, slot, or cut out 42 in its outer periphery. Cut out 42 is sized for accepting a lock bolt member 35 therein when the lock bolt member is extended. As a result, when lock 34 is in a secure, closed condition and the lock bolt member 35 is extended into the cut out 42, locking bolt mechanism 24 is prevented from moving and is secured in the position shown in Figure 4. In this position it should be noted that the locking bolt projections 68 (Figure 4 shows five projections) are extended outwardly. When the door is closed, this enables the locking bolt projections 68 to be engaged in locking bolt apertures 46 in the striker side panel 38 of the chest portion.

In the secure extended position of the locking bolt 60 shown in Figure 4, the drive cam 40 and the idler cam 50 each have a front surface that is in abutting or close adjacent relation with a back surface of locking bolt 60. This serves to resist movement of the locking bolt from its extended secure position. The abutting engagement can prevent movement of the locking bolt to the retracted position absent rotational movement of both of the drive cam and idler cam. The configurations of the drive cam and idler cam, which can include converging side walls which

extend to the respective front surfaces, enable the cams to be positioned and moved in the manner shown and described.

It should also be noted that in the secure position of the locking bolt 60 shown in Figure 4, the bolt links 54 and 56 extend in an "over center" relation relative to their respective idler cams. This over center positioning of the bolt links provides that during initial rotational movement of either idler cam in a direction that would tend to retract the locking bolt 60, the locking bolt actually moves slightly further outwardly rather than inwardly. As will be appreciated from the orientation of the components, a large rotational displacement of the idler cam 50, as well as the drive cam 40, is required before the locking bolt will retract a significant distance. This provides enhanced resistance to attack because limited movement of the cams or links will not enable significant movement of the locking bolt toward the retracted position.

As previously discussed, the locking bolt 60 can be held in the secure position shown in Figure 4 by the engagement of the lock bolt member 35 with the cut out 42 in drive cam 40. When lock bolt member 35 is retracted, such as in responsive to an input or a lock dial receiving the correct combination, then the drive cam 40 is again free to be rotated. One or more handles may be arranged on the exterior of the door 14 to enable rotation of the drive cam. The drive cam 40 may be arranged such that a counterclockwise rotation of the drive cam moves the cam link 52 in an upward direction. This movement rotates idler cam 50 in a counterclockwise direction. The rotation of the cams moves the bolt links 54 and 56 to retract locking bolt 60 to the position shown in Figure 5.

The retraction of the locking bolt 60 causes the locking bolt projections 68 to move out of the locking apertures 46 in the striker side panel 38. This enables the door 14 to be opened. Of course when it is desired to resecure the door, the door may be again moved to the closed position, such as by moving the drive cam in a clockwise direction. In this position the locking bolt 60 may again be extended such that projections 68 engage in the apertures 46 in the striker side panel, and the lock 34 may be changed such that lock bolt member 35 extends into the cut out 42 in the driving cam. This will again place the locking bolt mechanism 24 in a secured or locked condition.

It will be appreciated by those skilled in the art that the locking bolt mechanism, because it provides multiple places (e.g., projections 68) for engagement with an enclosure side panel, achieves more secure locking of the door in the closed position. In addition, the mounting of the locking bolt 60, as well as the nature of the forces applied to move the locking bolt, enables the locking bolt to be moved easily when the lock has been opened. This enables the locking bolt to be rapidly changed from a secure condition to an open condition by authorized personnel.

A further advantage of the locking bolt mechanism of the exemplary embodiment is that if one or more, or even all, of the bolt links are disconnected with the locking bolt in the extended position, the locking bolt cannot be moved to the retracted position. This is because the locking bolt engages the drive cam and/or the idler cam and is prevented from moving toward the retracted position until the drive cam and idler cams are properly rotated. This reduces vulnerability to a successful attack.

The assembly and arrangement of the locking bolt mechanism 24 will now be further discussed. Figure 7 shows a cut away top view of an (upper) end portion of the assembled locking bolt mechanism of Figure 4. The drive cam 40 may be of the type shown in Figure 9. The locking bolt 60 in Figure 7 is in an extended secure position. Figure 7 also shows the operative connections of the door 14, locking bolt 60, drive cam 40, lock 34, lock bolt member 35, bolt link 54, cam link 52, and a keeper or retainer 90.

A pin or shaft 78 can be used to secure the drive shaft 40 to the door 14 and secure the retainer 90 to the drive shaft. The shaft 78 may extend through the retainer 90 and the drive cam 40 and be fastened to the door 14. The shaft may comprise a screw or bolt. A nut 80 and a washer 82 may also be used in the fastening arrangement.

Another pin or shaft 70 and washers 74 may be used to operatively connect the links 52, 54 to the drive cam 40. The pin 70 may be free to move axially or it may be attached to the cam link 52 or the bolt link 54. The pin 70 may comprise a freely movable dowel pin or bolt. The drive cam and the bolt link and the cam link are rotatable on the shaft. Figure 15 shows an embodiment where the bolt link 116 has a shaft 118 affixed thereto. Figure 7 also shows an end portion 58 of the bolt link 54 extended into the locking bolt 60.

As shown in more detail in Figure 9 the retainer 90 may include a projection, lip, or tab 94 for extending into the cut out 42 in the drive cam 40. The engagement of the retainer tab 94 in the cut out 42 can be used to accurately position the retainer and/or to prevent the retainer from pivoting or rotating relative to the drive cam.

The retainer 90 can retain or keep the drive bolt link 54 from be removed from an opening 64 in the locking bolt 60. Therefore, the retainer is operative to prevent disengagement of the bolt link and locking bolt. The retainer 90 can also retain or keep the operative connection of the drive cam 40, cam link 52, and bolt link 54.

Figure 8 shows a cut away top view of an (lower) end portion of the assembled locking bolt mechanism of Figure 4 which includes the idler cam 50. The locking bolt 60 is shown in an extended locking position. Figure 8 also shows the operative connections of the door 14, locking bolt 60, idler cam 50, bolt link 56, cam link 52, and a keeper or retainer 92. Figure 18 shows a top view of an idler cam 50 which can be used in the arrangement of Figure 8. The idler cam 50 of Figure 18 has a passage 184 therethrough and apertures 186, 188.

The keeper 92 can retain or keep the idler bolt link 56 from be removed from an opening 64 in the locking bolt 60. The keeper is operative to prevent disengagement of the bolt link and locking bolt. The keeper 92 can also keep or retain the operative connection of the idler cam 50, cam link 52, and bolt link 56.

A shaft 59 functions similar to shaft 78. A shaft 98 functions similar to shaft 70. The shaft 98 may comprise a freely movable dowel pin. The idler cam and the bolt link and the cam link are rotatable on the shaft 98.

A dowel pin 96 may be used to position and prevent the retainer or keeper 92 from pivoting or rotating relative to the idler cam 50. Of course it should be understood that a tab may be used in place of a dowel pin. For example, a tab similar to retainer tab 94 may be fastened to or integral with the keeper 92 to function to position and/or prevent rotation of the keeper 92.

Likewise, the retainer 90 may be positioned with use of a dowel pin instead of the retainer tab 94. Also, a tab or dowel pin may be positioned at a predetermined location along the length of a retainer. It should also be understood that washers may be associated with the shafts and pins.

Figures 16-17 and 23-28 show examples of retainers. The retainer 90 of Figure 16 may be used in the arrangement of Figure 7.

A retainer may be engaged with a cam (i.e., drive cam or idler cam) by the use of another groove or slot in the cam. The retainer 108 of Figure 17 may be used with a cam having a groove. Figures 19-21 show a drive cam 128 having a groove 130 therein in which a portion of a retainer may rest. The groove and retainer portion arrangement is operative to prevent rotation of a retainer relative to the cam. Figure 20 shows the cut out 132 of Figure 19. Figure 20 is a front view of the cam of Figure 19 taken along the cut out. Figure 21 shows the groove 130 of Figure 19. Figure 21 is a view of the cam of Figure 19 taken along the groove. The groove is aligned in each of Figures 19-21.

A combination of a retainer tab and a cam groove may also be used. Figure 22 shows an embodiment having a retainer portion 136 resting in a groove 138 of a cam 140. The retainer portion 136 is also shown having a tab 142 extending in an opening of the cam 140.

Figure 23 shows another embodiment of another retainer 144. The retainer 144 includes a hook or lip portion 146. The lip portion is able to extend toward the links to assist in retaining the shaft which operatively connects the links. The lip portion is able to extend beyond the shaft end which is adjacent to the retainer. Hence, the retainer 144 is operative to cover a shaft in a surrounding manner.

Figures 24-25 show bottom views of retainer embodiments. The retainer 148 in Figure 24 is applicable with a portion of the retainer acting as a tongue in a groove of a cam. The tongue and groove arrangement can prevent angular movement of the retainer relative to the cam. The shown single passage or opening 150 in the retainer 148 is for passage of a bolt to fasten the retainer to the cam, for example a drive cam as shown in Figure 7.

The retainer 152 shown in Figure 25 has two openings. One opening 154 is applicable to receive a shaft which operatively connects the links, as previously discussed. The other opening 156 is applicable to receive a shaft to fasten the retainer to a cam, such as a drive cam. Other embodiments of a retainer associated with a drive cam may include an additional opening or aperture in the retainer in place of a retainer tab. The aperture is applicable to receive a dowel pin to prevent angular movement of the retainer relative to a drive cam without using a cam groove or a retainer tab. The dowel pin would also extend into a corresponding aperture in the drive cam.

Figure 26 shows another embodiment of a retainer 158. The retainer 158 includes a curved portion 160. Figures 27-28 show additional bottom views of retainer embodiments applicable with an idler cam. The retainer 162 in Figure 27 is applicable with an idler cam, such as the idler cam shown in Figure 8. The retainer 164 in Figure 28 is similar to the retainer of Figure 27 but additionally has a slot or aperture 166 to receive a shaft which operatively connects the links.

Figure 29 shows another retainer and cam arrangement. Fastening bolts 168, 170 and nuts 172, 174 may be used in fastening a retainer 176, bolt link 178, cam link 180, and cam 182.

As previously discussed, washers may also be used in the fastening arrangements. Figure 29 also shows that a locking bolt mechanism of the invention may be arranged with a cam link intermediate of a cam and a bolt link. It should also be understood that more than two bolt links may be associated with a cam link to provide greater engagement with a locking bolt. Furthermore, a cam link may be engaged with a bolt link which isn't engaged with a cam.

Figure 19 also shows an alignment device 100. The alignment device includes an adjustable bolt 102 and an adjusting nut 104. The alignment device includes a support 106 which is operatively connected to the door 14. The adjusting nut is adjustable to operatively position the bolt 102 so that the drive cam cut out 132 is aligned with a lock bolt member (e.g., member 35) of a lock (e.g., lock 34) to enable locking of the drive cam. The alignment device can act as a stop to accurately align a drive cam with the lock bolt member when the locking bolt 60 is in its extended locking position. The alignment device prevents further rotational movement of a drive cam. Figure 4 shows a drive cam 40 aligned to a locking position by an alignment device 44 for locking engagement with a lock bolt member 35. Figure 5 shows the drive cam 40 rotated to a non locking position.

The locking bolt work mechanism may be used with different types of automated banking machine doors. For example, an ATM may have a front load door and/or a rear load door. The invention permits the same bolt work to be used with either a front load door or a rear load door. For example, a locking bolt work mechanism of a front load door may be rotated 180 degrees for additional operation with a rear load door. Figure 30 shows identical locking bolt work mechanisms 190, 192 positioned on both sides of the same door 194. The locking bolt work

mechanisms are positioned relative to each other at a 180-degree rotation. That is, mechanism 190 can be rotated to obtain the position of mechanism 192. A locking bolt work mechanism is reversible and can be reversibly installed. Figure 30 shows that a locking bolt work mechanism may be installed on either side of a door. Thus, a form of the locking bolt work apparatus of the invention permits plural functionality by its capability of being used with different door arrangements.

It should also be understood that the components described herein may have additional shapes. Additionally, the drive cam, idler cam, locking bolt, and links may have portions removed (e.g., cut outs) therefrom to permit reduction of material.

An assembly embodiment of the locking bolt work mechanism will now be described with reference to Figures 4, 7, and 8. The door 14 may include pre-drilled apertures or mounted studs for fastening the cams to the door. The locking bolt 60 is installed on the studs 32 of the door. The drive cam 40 is positioned relative to the locking bolt 60 on a fastening stud or bolt 78. A washer 82 is positioned between the drive cam and an inner face of the door. A lip of the bolt link 54 is mounted into an opening 64 of the locking bolt 60. A dowel pin 70 is extended through the cam link 52, the bolt link 54, and washers and into an aperture of the drive cam 40. A retainer 90 is positioned in abutting relationship with the drive cam 40. The tab 94 of the retainer extends into the cut out 42 of the drive cam 40. The retainer is aligned such that it covers the dowel pin. The retainer 90 is loosely fastened to the drive cam 40 with a nut 80.

The idler cam 50 is positioned relative to the locking bolt 60 on a fastening stud or bolt 59. A washer is positioned between the idler cam and the inner face of the door. A lip of the

bolt link 56 is mounted into an opening 64 of the locking bolt 60. A dowel pin 98 is extended through the cam link 52, the bolt link 56, and washers and into an aperture in the idler cam 50. Another dowel pin 96, which is typically shorter than the dowel pin 98, is positioned in another aperture of the idler cam. A retainer or keeper 92 is positioned in abutting relationship with the idler cam 50. An aperture in the retainer 92 being aligned with and receiving the dowel pin 96. The keeper 92 is aligned such that it covers the dowel pin 98. The keeper 92 is loosely fastened to the idler cam 50 with a nut 86.

The drive cam 40 can be appropriately positioned relative to the lock bolt member 35 and the alignment device 44 adjusted to reflect that drive cam position. The fastening nuts 80, 86 can then be firmly tightened to secure the locking bolt work mechanism. Of course it should be understood that the method of assembly described herein is merely an example and that other assembly procedures or steps (and their order) may be used with the disclosed bolt work apparatus of the invention. For example, as previously mentioned, an assembly may include having a cam link intermediate of a cam and a bolt link.

In an exemplary embodiment the bolt work apparatus can be installed to a door using an efficient threaded fastener arrangements (e.g., two threaded bolts or studs and corresponding fastening nuts). Thus, the apparatus can provide for an efficient assembly, both in costs and time.

An alternative exemplary embodiment of a locking bolt work apparatus 200 is shown in Figure 31. Figure 32 shows an exploded view of Figure 31. The locking bolt work apparatus 200 includes a locking linkage arrangement different from that previously discussed with regard

to Figures 4 and 5. The locking bolt work apparatus 200 includes a drive linkage arrangement and an idler linkage arrangement.

Figure 32 shows a locking bolt (e.g., lock bar) 220. The locking bolt 220 may comprise a laser cut locking bolt. As shown in Figure 33, a door 216 can include stepped bosses 240. The stepped bosses 240 include a neck portion 242 and a head portion 244. The head 244 has a larger outer diameter than the outer diameter of the neck 242. The elongated locking bolt 220 can have elongated openings or key holes 228. The key holes include a wide portion 236 and a narrow portion 238.

The bosses 240 can function to locate the locking bolt 220. The wider portion 236 of a key hole 228 is able to slip over a stepped boss head 244. However, the narrower portion 238 of the key hole prevents passage of the head 244 therethrough. Thus, the bosses can be moved (e.g., slipped or slid) into the narrower portion of the key holes to secure the locking bolt in an operating position. For example, the locking bolt can be secured with the boss heads outside of the narrower portion of the key holes, as shown in Figure 34. The arrangement can eliminate the need of fasteners to secure the locking bolt.

The locking bolt 220 can be arranged to hang from the uppermost (e.g., top) stepped boss. The top boss can be operative to correctly locate (e.g., guide) and align (e.g., position) the locking bolt. In an exemplary form of the apparatus, the top boss alone can support the locking bolt. The other stepped bosses can be used for security only, eliminating the need for machining. For example, the other stepped bosses can be directed to providing securing of the lock bolt 220 via the narrower key hole portions. The locking bolt can be used with little or no machining,

especially regarding machining for alignment purposes. In other arrangements plural stepped bosses can be used to support the locking bolt 220.

The locking bolt 220 can also have a powder-coating (e.g., a powder-coat paint) applied thereto. The coating can be operative to reduce friction between mating parts. Thus, the need for (additional) lubrication such as grease can be eliminated. Additionally, the locking bolt 220 can be used for both front and rear load safes.

The drive linkage arrangement includes a drive cam. Figure 32 shows a drive cam 202, a link 204 (e.g., drive link or bolt link or lever or short link or upper short link), a connector 206 (e.g., cam link or lever or long link), and a keeper or retainer 208.

The drive cam may comprise a laser cut cam. The connector may comprise a laser cut cam link. The connector may also have substantially flat sides. A flat side can extend from one connector end to the other connector end along a common plane. The cam link may further have a wavy or curving configuration or shape (e.g., a W-shape or a C-shape with oppositely curved ends). The retainer can retain or keep the operative connection of the drive cam 202, the bolt link 204, and the cam link 206. The retainer 208 can comprise a plate.

The drive bolt link 204 and an end (e.g., upper or top portion) of the cam link 206 can be secured to the drive cam 202 by using the drive retainer (or drive plate) 208. The securing arrangement can be absent fasteners. That is, the drive cam, drive bolt link, cam link, and drive retainer connection can be arranged so that no additional fasteners are required. A connector comprising a shaft or pin 210 may be attached to, integral with, or one-piece with the retainer 208. The shaft 210 can protrude through aligned holes in the bolt link 204 and the cam link 206.

The shaft 210 can also extend into an opening in the drive cam. The shaft can provide a pivot for the bolt link and the bolt. The shaft 210 connects the drive cam and the bolt link and the cam link. The assembly arrangement can secure the bolt link 204 and cam link 206 intermediate the drive cam 202 and the retainer 208.

A fastener (e.g., a nut) 212 can be used to secure the drive retainer and drive cam. Thus, the fastener 212 can secure the drive linkage arrangement to the door 216. The fastener 212 may be (or include) the same nut that secures a door handle portion 214 to the door 216. The fastener 212 arrangement can provide a pivot for the drive cam and drive retainer.

A bushing 218 can be fastened to the bolt link 204. Alternative arrangements may include providing the bolt link 204 with an integral (or one-piece) bushing end portion. The bushing 218 can be inserted into a hole in the locking bolt 220. The bushing hole in the lock bolt may comprise a laser cut hole or opening. The bushing may be arranged in the bushing hole without being fastened to the lock bolt. The bushing can be retained in the hole by the securement of the drive retainer. However, alternative arrangements may include fastening the bushing to the lock bolt.

The idler linkage arrangement includes an idler cam. Figure 32 also shows an idler cam 222, a link 224 (e.g., idler link or bolt link or lever or short link or lower short link), and a retainer or keeper 226. The keeper 226 can keep or retain operative connection of the idler cam 222, the bolt link 224, and the cam link 206. The keeper 226 can comprise a plate. The idler bolt link 224 and an opposite end (e.g., lower or bottom portion) of the cam link 206 can be secured to the idler cam 222 by using the idler keeper (or idler plate) 226. The securing

arrangement can be absent fasteners. That is, the idler cam, idler bolt link, bolt, and idler keeper connection can be arranged so that no additional fasteners are required. A connector comprising a shaft or pin 230 may be attached to, integral with, or one-piece with the keeper 226. The shaft 230 can protrude through aligned holes in the bolt link 224 and the cam link 206. The shaft 230 can also extend into an opening in the idler cam. The shaft 230 can provide a pivot for the bolt link 224 and the cam link 206. The shaft 230 connects the idler cam and the bolt link and the cam link. The assembly arrangement can secure the bolt link 224 and cam link 206 intermediate the idler cam 222 and the retainer 226. The idler cam and the bolt link and the cam link are rotatable on the shaft.

A fastener (e.g., screw or shoulder screw) 232 can be used to secure the idler keeper and idler cam. The fastener 232 can secure the idler linkage arrangement to the door 216. The fastener 232 arrangement can provide a pivot for the idler cam and idler plate.

A bushing 234 can be fastened to the bolt link 224. Alternative arrangements may include providing the bolt link 224 with an integral (or one-piece) bushing end portion. The bushing 234 can be inserted into a hole (e.g., laser cut hole or opening) in the lock bolt 220. The bushing 234 may be arranged in the bushing hole without being fastened to the lock bolt. The bushing 234 can be retained in the hole by the securement of the idler plate. However, alternative arrangements may include fastening the bushing to the lock bolt.

In an exemplary form of the locking bolt work apparatus 200, the bolt links 204, 224 can be identical. Also, the bushings 218, 234 may be identical. Furthermore, the pins 210, 230 may be identical. Of course other arrangements may use dissimilar links, bushings, and pins.

The locking bolt work apparatus 200 allows for the use of fewer fasteners (e.g., screws), fewer or no washers, a laser cut locking bolt, a flat laser cut cam link, laser cut cams, and laser cut holes. Thus, the locking bolt work apparatus 200 can result in a reduced part count, a reduction in (or elimination of) machining, and easier assembly.

Figure 35 shows a door handle assembly 250 (e.g., bolt work handle arrangement). The handle assembly includes a sleeve 252 operative to locate and hold a handle 254. The sleeve can be attached to the door 256. The sleeve can have a tapered hole or inner surface 258 along its axis (e.g., through its center or middle portion). The tapered inner surface can receive or accept a tapered outer surface 264 of a handle shaft 260. The sleeve and handle shaft can share a common axis extending through a hole of the door 256. A handle lever 262 may be attached to, integral with, or one-piece with the handle shaft 260. The handle lever 262 is shown located on the outside of the door 256.

Figure 36 shows a separate view of the sleeve 252. Figure 37 shows a separate view of the door 256. Figure 38 shows a separate view of the handle 254.

The sleeve can have non-tapered ends which correspond to non-tapered portions on the shaft to provide for alignment of the handle relative to the door. That is, the shaft can have a tapered outer section intermediate a first constant outer diameter surface section 266 and a second constant outer diameter surface section 268. Likewise, the sleeve can have a tapered inner surface section intermediate a first constant inner diameter surface section 270 and a second constant inner diameter surface section 272. The first constant outer diameter surface section can match the first constant inner diameter surface section, and the second constant outer

diameter surface section can match the second constant inner diameter surface section. Thus, matching surfaces can achieve alignment of the handle.

The sleeve and the shaft may have angled tapers resulting in engagement over the entire length of the tapered surfaces. The tapered surfaces may also have engaging teeth. The sleeve can be secured to the door, such as by welding or expanding. The sleeve can also have a step or ledge 274 to prevent its passage through (i.e., out of) the door hole, as shown in Figure 35. The sleeve ledge can extend radially and circumferentially. The sleeve ledge may also comprise a circumferential series of separated radial projections. The shaft may be forced into the sleeve to prevent its removal therefrom.

The door handle assembly 250 provides additional security. For example, if the handle is broken off from the door through its shaft, then the remaining portion of the shaft cannot be forced (e.g., pushed) inwardly through the door. Rather, the two tapered surfaces would be pressed tighter together, preventing the shaft from being pushed through the door. Since the handle (e.g., via the handle shaft) cannot be forced through the sleeve, the locking mechanisms inside the safe would not be able to be disengaged. The safe may be that of an automated banking machine.

The door handle assembly 250 may be used in the locking bolt work apparatus 200. The door can correspond to the door 216. The handle shaft 260 may comprise the door handle portion 214. The shaft 260 may have a threaded portion operative to receive a fastener 212 such as a threaded nut.

The door handle assembly 250, with the relationship of the handle and sleeve as discussed herein, can add a new level of security to a safe.

Thus the new secure enclosure for an automated banking machine and method of the exemplary embodiment of the present invention achieves the above stated objectives, eliminates difficulties encountered in the use of prior devices and methods, solves problems, and attains the desirable results described herein.

In the foregoing description certain terms have been used for brevity, clarity and understanding. However no unnecessary limitations are to be implied therefrom because such terms are for descriptive purposes and are intended to be broadly construed. Moreover the descriptions and illustrations herein are by way of examples and the invention is not limited to the details shown and described.

In the following claims any feature described as a means for performing a function shall be construed as encompassing any means capable of performing the recited function, and shall not be deemed limited to the particular means shown in the foregoing description or mere equivalents thereof.

Having described the features, discoveries and principles of the invention, the manner in which it is constructed and operated and the advantages and useful results attained; the new and useful structures, devices, elements, arrangements, parts, combinations, systems, equipment, operations, methods, processes, and relationships are set forth in the appended claims.